

BLUEPRINT



SEEKING EXCELLENCE
An interview with
Scott Johnson – page 4

**Proper Radiant Barrier
Installation**– page 2

**The 2005 Standards
have been adopted
WHAT's NEXT?**– page 9

Questions and Answers

Residential

Q

Are there special Standards requirements when replacing HVAC systems in residences?

A

Yes. New heating and/or air conditioning systems installed in existing buildings are considered alterations. The alteration requirements for low-rise residential buildings are in § 152 (b) of the Standards. That includes the requirements in § 111 that the appliance efficiency regulations must be met. Also, the applicable mandatory requirements for low-rise residential buildings must be met, including §150 (h) that requires that systems be appropriately sized and §150 (i) that requires that the new systems have setback thermostats. For prescriptive compliance, § 152 (b) 1 B i specifies that the prescriptive requirements in §151 (f) 7 be met; this requires that new split system air conditioners or heat pumps installed in existing buildings must either be verified to have a thermostatic expansion valve (TXV) or be diagnostically tested to verify the correct refrigerant charge and airflow, and to provide remediation if needed. As an alternative to the requirements for field verification and diagnostic testing for refrigerant charge and airflow measurement or a TXV, an air conditioner or heat pump with an SEER of 12 or greater may be installed. As an alternative to the prescriptive requirement for a TXV, refrigerant charge and airflow

verification, or a SEER 12, compliance may be shown using the “existing plus alteration” performance approach; the mandatory requirements of §’s 111, 150 (h) and 150 (i) must also be met when using the performance approach.

Q

Does electric resistance space heating in a bathroom have to be modeled?

A

Not in most cases. If the bathroom is served by the primary heating system, then the electric resistance heater is considered supplemental and does not have to be modeled. If the bathroom does not have a supply vent from the primary heating system, the need to model the electric resistance heating depends on the types of controls that the electric heater has. If the heater has a timer that limits its operation to 30 minutes or less and there is a primary heating system for the building with sufficient capacity to heat the bathroom, then the electric resistance may be considered supplemental to the primary heating system for the building and does not have to be modeled. If no timer exists, then the heater must be modeled as part of the heating system in the building energy compliance.

Q

When installing a radiant barrier, doesn't the foil side face up towards the shingles?

A

When installing a radiant barrier on the roof truss system, top chords, or other roof support, the shiny foil side faces down toward the attic floor.

This seems counterintuitive. Metallic foil has high reflectance but low emittance. It easily reflects most types of heat energy from the roof it contacts and does not easily emit the relatively small amount of heat energy toward the ducts and attic floor it absorbs. This is an advantage in the attic – heat entering a building and passing through the roofing materials will be reflected back outward by a radiant barrier, and what little heat energy is absorbed by the foil barrier will not be transferred downward into the attic space.

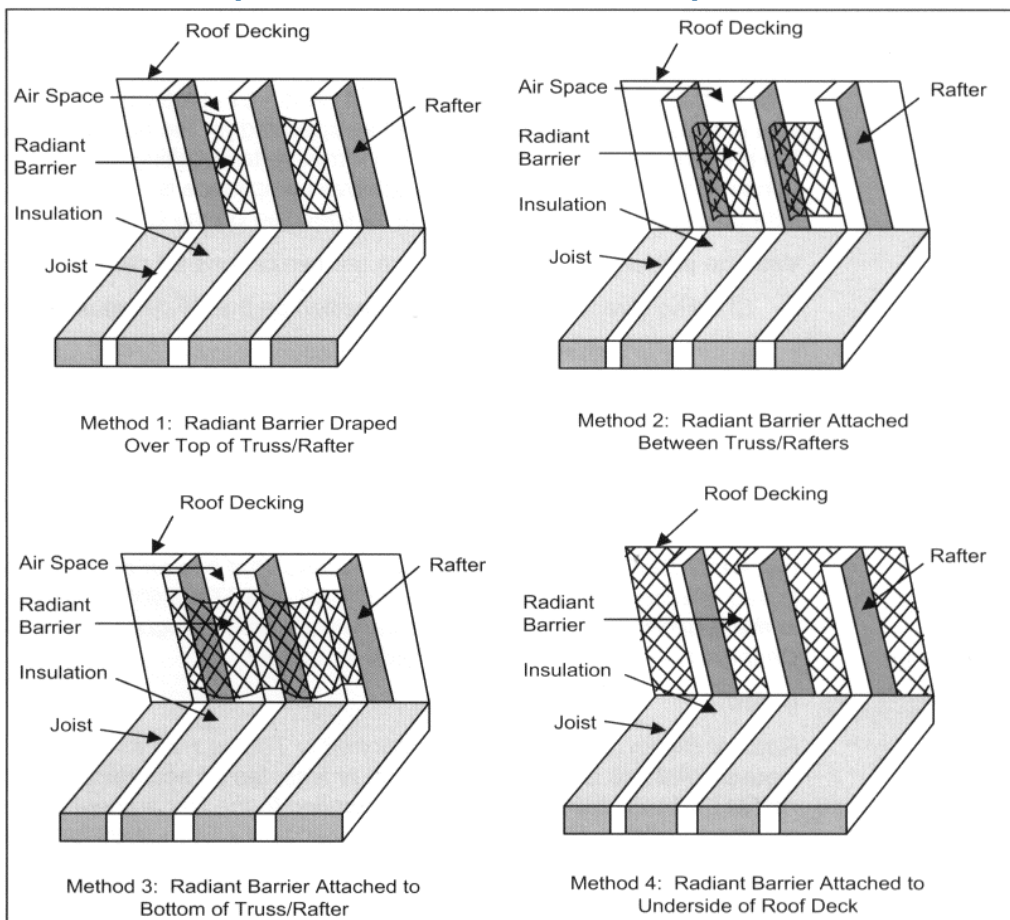
The point of a radiant barrier is to keep heat



energy from the sun from penetrating the roof, radiating into the attic space and then being transferred into the conditioned space. The reason that you don't want to have the shiny side facing up is that its' surface has the lowest emissivity, and you want to minimize radiant transfer to the ducts and attic floor.

The lowest emissivity surface must be on the side of the radiant barrier oriented toward the

ducts and attic floor. Dust will accumulate on the top surface of the radiant barrier over time, but not nearly so much on the bottom surface. If a heavy accumulation of dust were to build up on the shiny side (the high reflectance surface), the reflectance would decrease and allow more heat to be absorbed and radiate through to the attic below.



Nonresidential

Q *The California Building Code (CBC) Section 1202.2.1 requires ventilation of 15 cubic feet per minute (CFM) for each occupant when a building is mechanically ventilated. The CBC also sets maximum occupancy loads for egress purposes (in Section 1003.2.2.2 and Table 10-A). However, the Building Energy Efficiency Standards (Section 121(b) 2 B) says that the minimum ventilation requirement for areas without fixed seating is 15 CFM times half the maximum occupancy loads. Are the requirements of the two codes inconsistent?*

A No. The CBC does not say that the maximum occupancy loads are to be used to determine minimum ventilation rates.

The Building Energy Efficiency Standards recognizes that the number of occupants is a designer decision, and the designed HVAC system has to be capable of providing the ventilation based on that decision. The Standards do set minimum limits on the designer's decision: if there is fixed seating, the designer can't design for less than the number of fixed seats; if there is no fixed seating, the designer can't design for less than one-half the

maximum occupant load for egress that is specified in the CBC.

Some people might think that the CBC implies having to meet ventilation rates assuming the maximum occupant load for egress purposes. That would require that the HVAC system be designed not to meet the normal number of occupants but to meet the maximum number of occupants that could exit through the doors in an emergency. That would not be prudent because the maximum occupancy load requirements for egress allow for a lot more people in the space than may be normal. For example, for gymnasiums the maximum occupancy load for egress is one person per 15 square feet; everybody in the gym is allotted a 3 x 5 foot space. Rarely would a gym have this many people in it. It doesn't make sense to size the HVAC system to provide ventilation for that many people every minute that it is on. The Energy Standards designate a reasonable minimum – ventilation for half the maximum number of occupants for egress purposes – and designers can design for more than that minimum if they think that is appropriate.



SEEKING EXCELLENCE

The second in a series of articles about building department employees, builders, energy consultants, HERS raters and others who are making exemplary efforts to achieve energy efficiency in buildings.



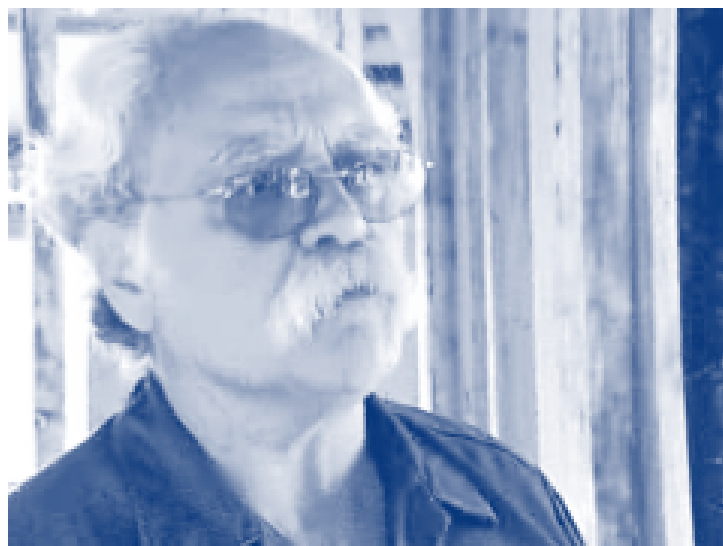
Scott Johnson exhibits an unsurpassed enthusiasm for energy efficiency and quality HVAC installation. He continually inspires

builders to exceed the requirements in the Energy Efficiency Standards for all of the homes they build.

Scott is an energy consultant, general contractor, Home Energy Rating System (HERS) rater, trainer and HVAC expert, who believes in an integrated systems approach to building houses. He feels strongly that the house is a system, with all of the elements working together based on proper design and installation.

He was the chief third-party inspector for the City of Irvine's voluntary "IQ+" program, which was the prototype for the "sealed ducts" standard. He has provided training and inspections for the Southern California Gas Company in much of Southern California, teaching hundreds of builders, building department staff, HVAC subcontractors and others about the proper installation of HVAC systems.

Scott has also undertaken numerous projects for the Energy Commission and is featured in a number of the Commission's on-line training videos.



Blueprint: Tell us about your background.

Johnson: I grew up in the construction trades and am a third generation contractor in Orange County. Normally kids grow up and have holidays and weekends free, but my free time was spent on construction sites. I was qualified to be a journeyman carpenter by the age of 12, but had to wait until I was 16 to get my union card. By the time I was 25, I had become a

journeyman in most of the existing trades. I learned the new trade of installing fiberglass insulation when it started in the late sixties and early seventies. The last trade I learned was HVAC.

Going to HVAC trade school allowed me to be around engineers and scientists, and the mystery of comfort and HVAC performance started to become clear for me. Having built

hundreds of houses, I took my practical background and coupled it with physics. I loved the opportunity to attend PG&E training classes, and then a new thing showed up: the California Home Energy Efficiency Rating System (CHEERS). I was in the first training class open to the public and became a CHEERS rater. I saw that I could take my experience and use CHEERS to put together everything to help people with comfort, health and safety.

I realized the most important thing I could do was to diagnose and fix houses so that they functioned properly. I love to help people be more comfortable, keep more money in their pockets with utility bill savings, and protect the environment all at the same time. This was a turning point for me. This became my mission.


PG&E helped CHEERS kick off a program to rate homes by offering rebates. I was audited by PG&E because, "it appeared it was impossible" to perform the quantity of ratings I had on the books. Their audit proved that not only did I actually do all the work, but I also did quite a good job on each home. I went way beyond the call of duty. I was given an award for excellence in performing and producing the highest number of ratings by PG&E and CHEERS in 1993.

After the rebates went away, many people told me that there was no money in this type of work, and that I wouldn't survive. I was concerned, but I loved it and knew that this was the right thing for me to do, so I kept plugging away.

California Pacific Homes (Cal Pac) was the first builder that bought into the IQ+ Program. They believed well-above average quality was not enough for them and that the typical production housing construction process left much room for improvement in occupant comfort and lower utility bills.

Brian Blain with Cal Pac led the charge to

"I realized the most important thing I could do was to diagnose and fix houses so that they functioned properly. I love to help people be more comfortable, keep more money in their pockets with utility bill savings, and protect the environment all at the same time. This was a turning point for me. This became my mission."



produce a top-notch quality product way above and beyond the code. In fact, Cal Pac called me in recently because they want to move forward with fully commissioning homes, which I think is the way of the future. This all got started by the foresight of the City of Irvine and the Energy Commission.

Blueprint: What other builders are you working with?

Johnson: We now work with over 60 builders, on one level or another. Many builders now want to build the "perfect energy efficient house,"

including ducts in conditioned space.

There is a particular builder that works primarily in the heat of Climate Zone 15. We have been diagnosing problem houses for them for a while now, and they have become ready and willing to participate in a training program. We started with all their staff of 35 people. After the first training session they decided to make changes in their standard practices. They realized that building correctly provides more comfortable homes and lower utility bills. They can promote a lot of sales through word-of-mouth.

Consumers are becoming better educated about energy efficiency and comfort issues. One way this is happening is through the videos on the Energy Commission website. I recommend these videos to everyone.

Also, HVAC subcontractors are starting to take advantage of the training programs offered by the utilities and trade groups. Pro Star Mechanical has asked for a comprehensive HVAC diagnostics training program in their Anaheim and Del Mar locations so they can extend the whole "house as a system" approach and apply it to commercial buildings.

Blueprint: How can the construction industry improve?

Johnson: I've never met with a builder or

subcontractor that does not want to build a better product. Once a builder understands how a house functions with regard to comfort and energy efficiency, they are armed with conceptual tools to build better. Consumers are beginning to see the light and are willing to spend some extra to get the house built right at the outset. Once the consumer understands the “cost effectiveness” of the extra dollars up front, they will insist on the better house.

Blueprint: Are the codes protecting consumers?

Johnson: Yes, the codes are designed to protect them, but the typical inspection process doesn’t take into account quality regarding comfort and energy efficiency. If we have return air duct leakage of 25 percent from a 150 degree attic, what happens to comfort and energy efficiency? If an R-30 fiberglass batt is installed in an attic in such a manner that 150 degree attic air is bypassing it and going straight to the drywall, and then conducting into conditioned space, what happens to comfort and energy efficiency?

You can’t see air leaking or heat movement. As a HERS Rater, I know where the likely problems will occur, because I understand the physics of air, heat and pressure. I can usually visually find where there will be a problem up front and I have the testing expertise to find a solution. Raters are a major resource to the building departments.

My heart really goes out to the building code enforcement agencies they are very overworked. The Title-24 energy codes are quite specific and the expertise to understand and enforce the codes in their entirety quite a responsibility. New codes and standards in 1998 introduced HERS raters as special inspectors. The building departments don’t have time to perform these extra tasks because they are overwhelmed with health and safety issues already. In my opinion the building departments need our help to get the industry back to the intent of the codes and get each house to function as a system.

Unfortunately, there are many buildings out there that are supposed to have HERS verifications, but it is not always happening. One way to ensure HERS verification would be to list “HERS” on the building department’s inspection cards. It would be a huge help if the building departments did this.

Blueprint: Does your experience indicate that houses are getting more energy efficient?

Johnson: Yes, there is improvement, and it seems to be accelerating in some geographic areas. It is obvious that the building departments have had a huge impact with energy efficiency when the HERS verifiable measures are enforced. I’m seeing more and more Building Department personnel at seminars and training events, and more and more builders and subs are also becoming aware of available training to help with energy efficiency and comfort issues.

The way we conduct our business, we don’t just go out perform a test and then say, “sorry you failed” and then just walk away. We incorporate training into every job. We go through a training process with the builder’s superintendent up front, or the HVAC contractor, if it’s an HVAC issue. We explain to them what we do and why we do it, and what it means to them. At the beginning of the job we use theatrical smoke during a duct blast test, to help the installers and subcontractor understand where their air leakage points would be. Of course, at the same time, we try to give them a general overview of what we are seeing, as far as restricted ducts, and other possible problems with airflow and insulation. We do as much as we can to make them aware of these issues.

Blueprint: You talk a lot about the whole house working as a system. What kind of problems do you see with the installation of insulation?

Johnson: I seldom see a house that is actually performing precisely to the intent of the design regarding the thermal boundary.

Blueprint: The new 2005 Energy Efficiency Standards give credit for the proper installation of insulation, after field verification. Do you think that will help?

Johnson: It’s going to make a huge impact as far as quality of installation! Builders will start paying attention to areas for improvement. They may meet with their insulation subcontractors to discuss if there are any additional costs associated with installing insulation correctly in the manner that all insulation experts agree upon.

Blueprint: So you are saying that it is actually not that costly to install insulation properly?

Johnson: Absolutely not!

Blueprint: What are the typical problems with the installation of attic insulation that you see in the field?

Johnson: In production housing, most of the time there are gaps between the insulation and the air barrier (ceiling drywall). Where gaps do exist, the hot attic air can bypass the insulation and penetrate through to the conditioned surface. This causes a short circuit of the intended thermal boundary. Most of the time, what I see is the insulation in the attic functioning as only a limited or nonexistent thermal boundary. The bottom line is the insulation should be installed so it is functioning as a full thermal boundary, in substantial contact with the conditioned surface – no gaps, no voids, no over-compression.

Blueprint: What about wall insulation?

Johnson: We have the same types of problems. Typically there are voids, gaps, insulation overly compressed, not in contact with the air barrier (wall drywall) and missing support to hold it in place. Unfortunately, missing insulation is a problem throughout the house. The building inspectors come out and inspect, but they really don't have the time needed to see that the job is well done. They inspect and then leave, after that any number of problems can occur. Insulation can get knocked out of the wall, ceiling or floor cavities and before you know it the cavity is covered with sheetrock.

Blueprint: So in a 2000 square foot house it might cost the builder \$200 to \$300 more to get the insulation right?

Johnson: It takes a minimal amount of money to



Scott Johnson and energy expert Steve Easley discuss duct testing in one of the Energy Commission's online training videos.

install the insulation correctly. Especially considering the gigantic cost effectiveness and comfort it produces by getting it in the right way.

Blueprint: It sounds like we still need third-party verification and training because the building department doesn't have the time to do this, right?

Johnson: Correct, Government inspectors have their hands full already. They need all the help they can get.

Blueprint: What about windows, fenestration and glazing? Isn't there a big difference in the energy efficiency of windows being installed these days?

Johnson: Yes, the design and materials used for manufacturing fenestration products has radically improved over the last 10 years. Since the 1998 Standards it is more difficult to achieve minimum compliance, and many builders use better, more energy efficient windows to comply. This is a very good thing. But

what I see in the field is that what is actually installed often does not match the design.

Way too often, I see windows, sliding glass doors and French doors without temporary labels. Sometimes I see them come right off the truck without the labels.

I often ask the local inspectors, "Have you inspected the windows yet?" Very often their idea of inspecting the windows is, "Well, it has dual panes with a vinyl frame, there you go!" However, the efficiencies listed in the calculations (CF-1R & or CF-2) need to be matched up with the temporary labels.

Blueprint: One of the things you are saying is

that by training builders, superintendents and subcontractors, change can occur. Correct?

Johnson: Absolutely. But the builder first needs to understand if there is a problem. Nothing can happen without the builders' participation.

Blueprint: How do builders benefit from energy efficiency?

Johnson: The Standards requirements for quality installation and HERS rater field verification will actually help the builders' bottom-line profit in many different ways. Our company, for instance will relieve some of the onsite superintendent's heavy workload. Allowing him to concentrate on the other trades.

Another way it will help the builder is through less call-backs from homeowners. I'm firmly convinced that homeowners will be more satisfied with a house if they are comfortable in it and their energy bills are low. Word of mouth sales referrals from happy homeowners can mean lower marketing costs, and that improves a builder's bottom-line.

Right now is the perfect time to take advantage of the utilities' "Energy Star Homes Program" to help offset the cost of energy efficiency improvements, and at the same time get into the groove for future code changes. The Energy Star Program, in my opinion, is a great vehicle to start everybody down the road of energy efficiency with overtones of the "House as a System".

Blueprint: Where do you think we're going from here?

Johnson: The energy efficiency codes are going to continue to tighten up to protect the consumer and maintain the reliability of the energy grid. Consumers are going to continue to be better educated, hopefully by such means as more streaming videos on the CEC website. Some builders and contractors are going to continue to blaze a trail for others to follow.

The utilities will continue to implement programs to encourage going beyond the standards. As for houses, it's really a no-brainer:



design the house properly, build it to that design, and then verify it through proper diagnostics and inspections. The energy bill guarantee programs have proven over the last 20 years that we can build a house with an effective thermal boundary with excellent results.

Blueprint: How do we get there?

Johnson: There is a lot of discussion, in California and across the nation, that we have a problem with energy and jobs. We could go a long way to solve both problems, at the same time, if we concentrated on where we live, our homes and our work places.

Blueprint: Any final tips to building departments?

Johnson: There is some confusion out there regarding compliance forms. The CF-6R (installation form) has been required at least since the early 1990's. Since the 1998 Standards have been implemented measures that require HERS verification and testing have been added to the CF-6R. The HERS portion of the CF-6R is not valid until a HERS Rater verifies the content and accuracy of the information on the CF-6R and the HERS sampling procedures have been completed.

The CF-6R must be available on site for the HERS Rater. CF-6R's must contain at minimum, required information from the HVAC system, Fenestration, Hot Water System, and the HERS verification and tests (if required). I urge building departments to reach out to HERS raters and ask for help. We are special inspectors to building departments. Find out what we are doing and make sure we are qualified. You as building officials and inspectors are the last line of defense for the consumers.

As soon as the building department sees that HERS verification is required, they should stamp on the plans in red ink that these measures are required. Alert the builder. Some of the time the builder doesn't realize that it's needed. If the building department enforces this, the builder will realize that there is something different going on here.

The California Energy Commission does not endorse any products, supplier, manufacturer or builder.

The text in this interview is meant to be informational and not all inclusive.



What's coming in the **2005** standards ?

At its November 5, 2003 meeting, the California Energy Commission adopted the 2005 Energy Efficiency Standards for Residential and Nonresidential Buildings, incorporating new measures to reduce energy use. In this brief overview we explain some of the changes, and some of the next steps that will be taken before the new standards go into effect on October 1, 2005.



One of the most cost-effective, efficient, and environmentally beneficial methods of meeting the state's energy needs is to encourage the efficient use of energy. Governor Schwarzenegger's State of the State address pointed out that California's energy crisis is not over, and that California could face energy shortages as early as 2006. Many of the changes in the Standards are focused on encouraging energy efficiency measures that are particularly effective at reducing peak demand.

A major goal of the 2005 update was to thoroughly review the Standards and supporting documents and to improve their clarity. Many of the sections of the Standards and supporting documents have been substantially re-written and reorganized to make them more understandable.

The Commission completed an extensive public process in developing and adopting these regulations. Utilities, the California Building Industry Association, the California Building Energy Consultants, and the Natural Resources Defense Council, among others, supported the approved changes.

THE MOST SIGNIFICANT CHANGES IN THE PROPOSED 2005 BUILDING ENERGY EFFICIENCY STANDARDS

ALL BUILDINGS:

Time Dependent Valuation – favors peak energy saving measures over off-peak measures

New Federal Air Conditioner and Water Heater Standards – go into effect, basis of the energy budgets (applies to residential and to many commercial buildings that use “residential size” air conditioners)

NONRESIDENTIAL BUILDINGS:

Cool Roofs – requires new and reroofing of nonresidential low-slope roofs with highly reflective roofing materials

Acceptance Requirements – sets guidelines for basic “building commissioning” for equipment prone to be installed improperly

Demand Control Ventilation – allows for sensors that vary ventilation depending on CO₂ levels in spaces with varying occupancy like conference rooms, dining rooms, lounges, gyms

T-bar Ceilings – prohibits insulation on t-bar ceilings (must be insulated at the roof or on hard ceilings)

Relocatable Public School Buildings – establishes special compliance approaches for relocatables so they can be moved anywhere statewide or they can be designed for specific climates

Duct Efficiency – requires mandatory R-8 duct insulation, duct sealing with field verification for ducts in unconditioned spaces in new buildings and when air conditioner is replaced

Indoor Lighting – sets lower power limits to encourage new efficient equipment

Skylights in Big Box Buildings – recommends skylights with controls to shut off the lights when daylight is available (buildings > 25,000 square feet with > 15 foot ceilings)

Efficient Space Conditioning Systems – addresses variable air volume, variable speed drives, electronically-commutated motors, better controls, certified cooling towers, have to use efficient cooling towers not air-cooled equipment on large systems

Unconditioned Buildings – sets lighting requirements pursuant to SB 5X (e.g., warehouses, parking garages)

RESIDENTIAL BUILDINGS:

Efficient Lighting – requires high efficacy (e.g., fluorescent) in all permanent lighting or controls; high efficacy in kitchens; high efficacy or motion sensor in bathrooms, utility rooms, garages, laundry rooms; high efficacy or motion sensor or dimmer in other lighting; high efficacy or combined photo sensor/motion sensor for exterior lights; airtight can lights

Duct Insulation – establishes levels depending on climate zone (R-4.2, R-6 or R-8)

Pipe Insulation – requires hot water pipes to the kitchen that are $\frac{3}{4}$ ” in diameter or greater have to be insulated

Replacement Windows – requires them to be high performance

Duct Sealing – requires sealing when air conditioner/furnace is replaced or ducts are replaced

Compliance Credit – allows credit for high EER air conditioners, gas cooling, high quality insulation installation, properly sized air conditioners, efficient air conditioner fan motors, ducts buried in attic insulation

OUTDOOR LIGHTING (SB 5X):

Covered Lighting Applications - establishes guidelines for lighting for automotive vehicles (e.g., parking lots), hardscape for pedestrian use

(e.g., walkways, plazas), building entrances, outdoor sales lots (e.g., car lots), vehicle service stations, sales and non-sales areas under canopies, ornamental lighting

Lighting Power Limits – establishes requirements by lighting zone depending on how much illumination is needed (national and state parks, rural areas, urban areas, highly lit areas)

Shielding – allows “cutoff” fixtures to save energy by reducing glare

Bi-level Controls – allows lighting to be shut off to half level when not needed

SIGNS (SB 5X)

Lighting Power Limits requires efficient lighting sources for indoor and outdoor signs

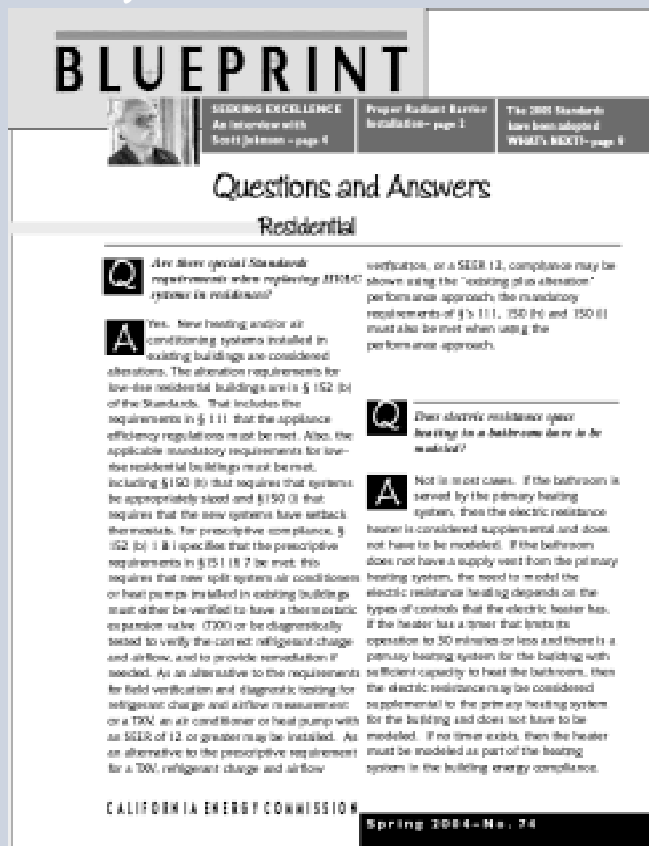
Next Steps

The Energy Commission will work closely with building officials, builders, energy consultants and the utilities to provide training for the implementation of the new standards. Residential and Nonresidential manuals are now being readied for publication and should be available by late summer of 2004.

Utilities may provide incentives for early adopters. The Commission also is working on a special compliance credit from now until October 1, 2005 for builders who meet the new residential lighting standards in advance.

The utilities are planning to offer training on the new Standards, and some classes have already been scheduled. Contact your local utility for information. The Blueprint also will keep you updated on training opportunities for the new standards.

A more detailed article on the standards will appear in a future issue of the Blueprint.



The Blueprint will soon be published electronically and distributed by e-mail.

Our future plans include distribution of this newsletter by e-mail as a pdf. A letter has been sent to you to update our mailing list to add your e-mail addresses. Please respond to the information requested in the letter, or call the Energy Hotline at (800) 772-3300 or e-mail us at title24@energy.state.ca.us.

The Blueprint is also currently available on the internet in pdf format at: www.energy.ca.gov/efficiency/blueprint/index.html.

Energy Videos

The Energy Commission Training videos are available both at:
www.energyvideos.com or
www.ConsumerEnergyCenter.org/videos/

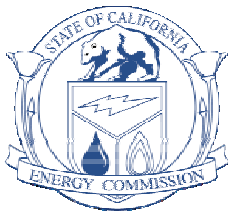


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INSIDE THIS ISSUE:

Residential

Replacing the HVAC in a residence.....Page 1

Electric Resistance Space Heating.....Page 1

Proper Installation of a Radiant Barrier.....Page 2

Nonresidential

Ventilation conflict?.....Page 3

Seeking Excellence

A series of articles about building department personnel, builders, energy consultants, HERS raters and others who are making exemplary efforts to achieve energy efficiency in buildings.

an interview with Scott Johnson.....Page 4

What's Coming in the 2005 Standards?..Page 7

Now that the Standards have been adopted, what are the most significant changes and what are the next steps in the process .

DID YOU KNOW?

The Blueprint by e-mail and on the web.....Page 11

